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LANDSAT-4 THEMATIC MAPPER

MODULATION TRANSFER FUNCTION (MTF) EVALUATION

(E85-10055 NASA-CR-174228) LANDSAT-4
THEMATIC MAPPER MODULATION TRANSFER FUNCTION
(MTF) EVALUATION Progress Report, 15 Jun. -
15 Sep. 1984 (Arizona Univ., Tucson.) 8 p
HC A02/MF A01

N85-16250
Unclassified
CSCL 08B G3/43 00055

Progress Report

June 15, 1984 - September 15, 1984

submitted to

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Introduction

During this contract period, we have refined the techniques used in the two-image comparison of TM data and 7-meter aerial data acquired over San Francisco on August 12, 1983 during Landsat-4 operation. Analysis of one area has been completed and is reported here; analysis of a second area is in progress. During this period we have also constructed a large test target for measurement of the Landsat-5 MTF at the White Sands Missile Range, New Mexico.

MTF Results - San Jose study site

Preliminary results of two-image analysis was reported in the last progress report dated August 15, 1984. More complete and reliable MTF data are included here in Figures 1-3. The substantial improvements in noise reduction and symmetry of the MTF over the earlier results is attributed to:

1. Selection of a different study area having more high frequency content such as edges and roads. The present area is the San Jose Sewage Plant facility.
2. Better geometric registration by using more control points (possible with the greater number of detailed features in this area) and a higher order polynomial transformation. The present area is also near the centerline of the aerial data, thus minimizing perspective distortion.
3. Additional data smoothing of the real and imaginary parts of the transfer function by averaging over six angular increments of 30 degrees each. This step probably results in the greatest improvement in the latest MTF data.

As can be seen from Figures 1-3, the MTFs indicate approximate symmetry in all directions. The average TM IFOV calculated from these curves is 52.7m and is consistent with the San Mateo Bridge analysis reported earlier. One final correction remains to be applied to these data, namely one for a 4X magnification step applied early in the processing to the TM data. This correction will tend to increase the MTFs slightly, and correspondingly decrease the IFOVs. The final improved analysis procedure is currently being applied to a different area near the earlier analyzed Stockton site; these results will be reported in the next progress report.

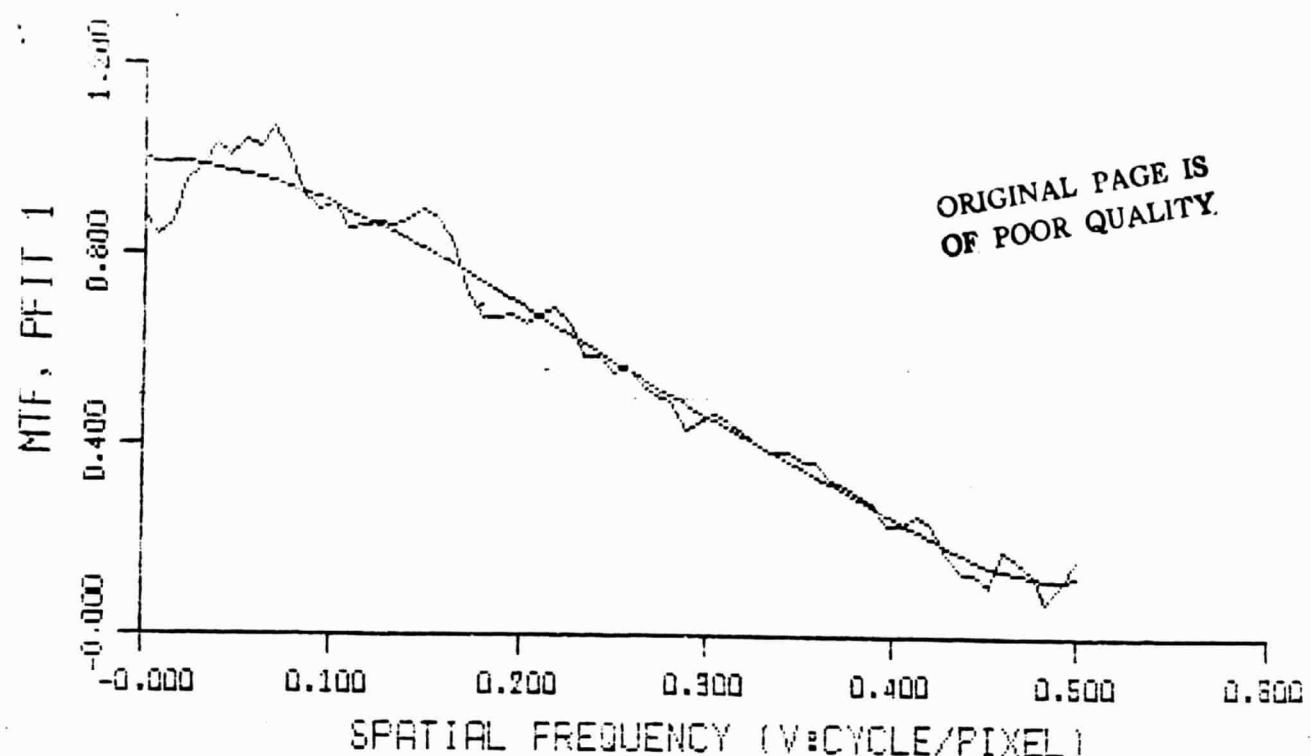
MTF Target - White Sands Missile Range

In an attempt to improve the reliability of MTF measurements of the TM from operational imagery, construction of a special target was proposed for the Landsat-5 operating period. The nominal design parameters of this target are shown in Fig. 4. The $\frac{1}{4}$ IFOV black squares were estimated to be sufficiently large to produce a gray level contrast in the TM image of at least 20 levels, depending on the exact spatial phase between pixels and the square.

In July and August, 1984, approval was sought and granted from the Army to construct this target on the southern end of the White Sands Missile Range. The final target site was selected for the following reasons:

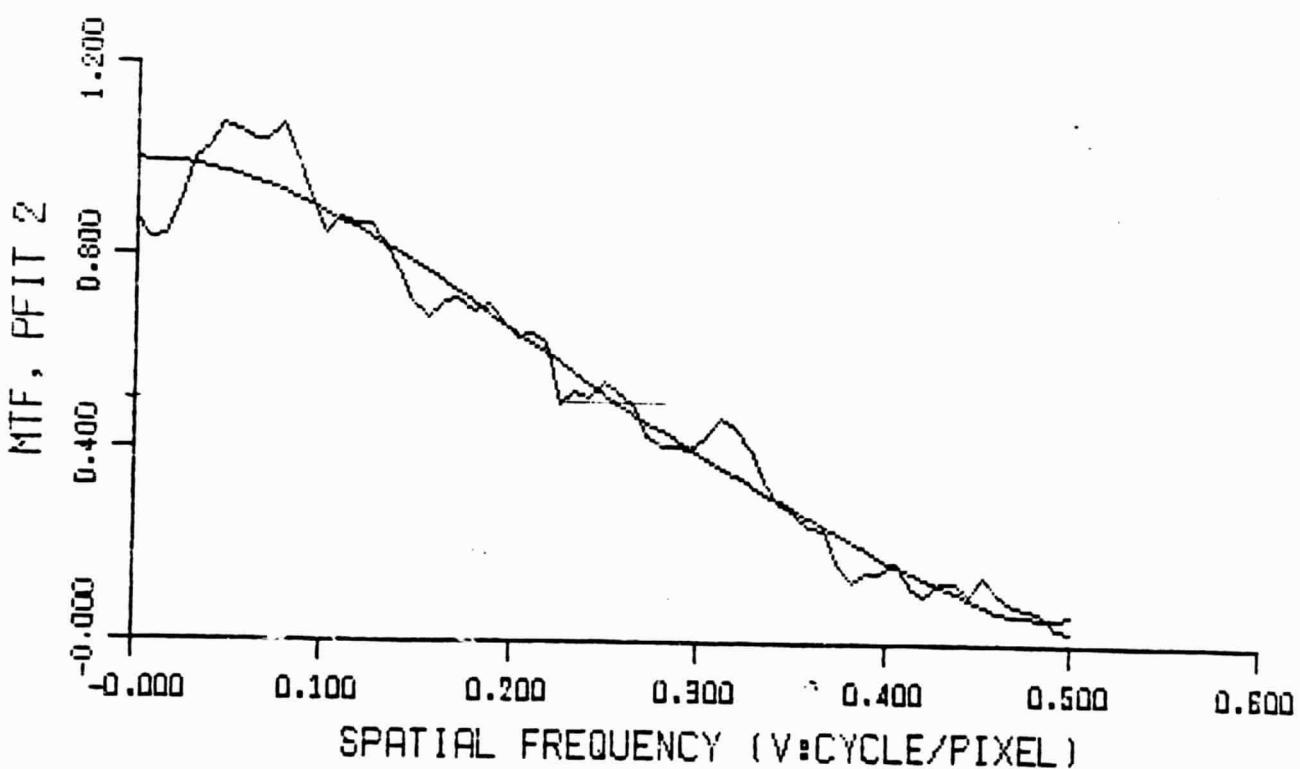
1. Uniformity of white sand background
2. On the western edge of the range to minimize deposition of windborne sand since prevailing winds are SW-W to NE-E.
3. Proximity to Dr. Slater's atmospheric and calibration measurement site, thus permitting use of his data if desired.

The final site is shown on the map in Fig. 5. An initial visit to Slater's site and the target site was made on 9/9/84-9/10/84 and surveying for the target and construction were planned for the latter half of September.



SJS TM1/MSS3 MD3

a. angular region # 1



SJS TM1/MSS3 MD3

b. angular region # 2

Figure 1. TM system MTFs from two-image analysis - San Jose site

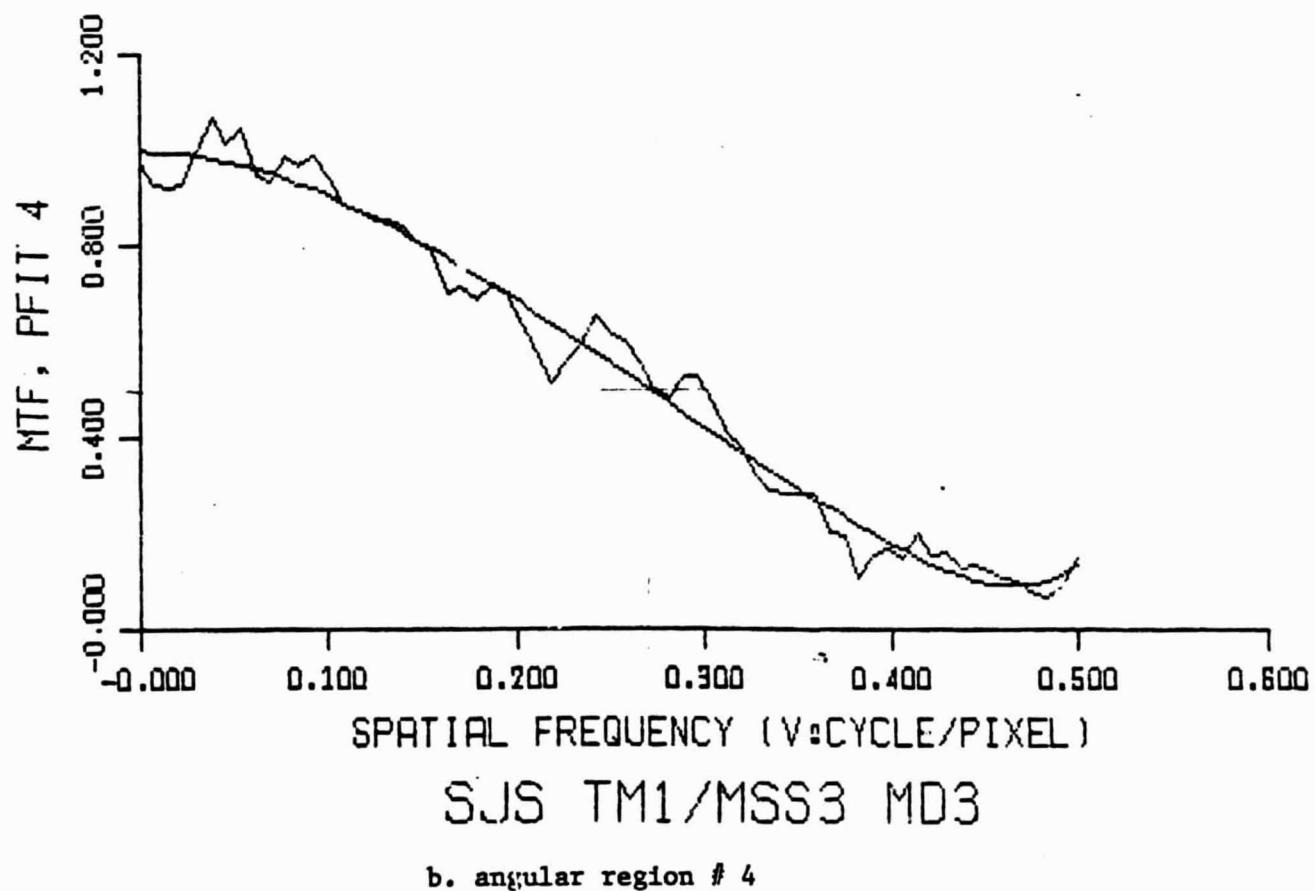
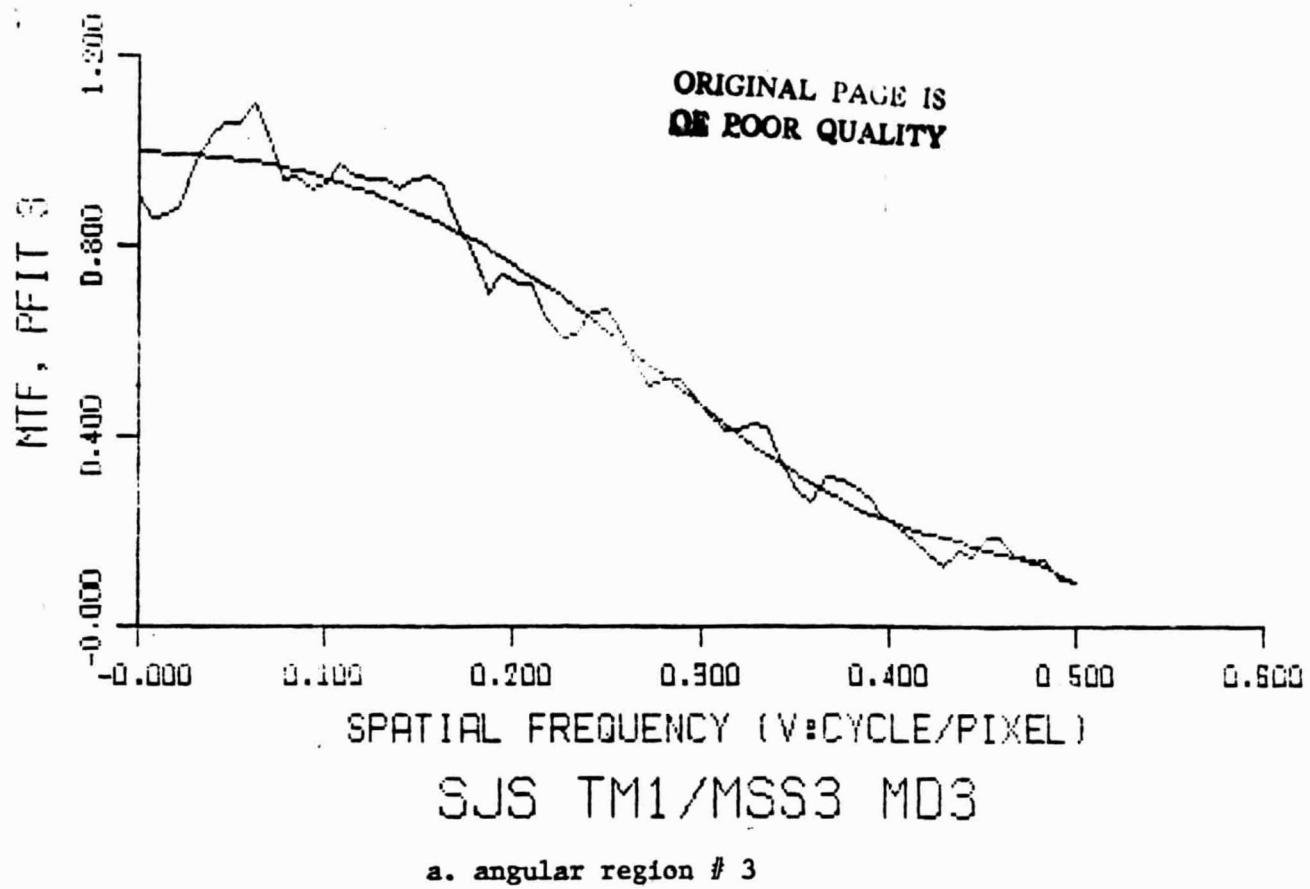
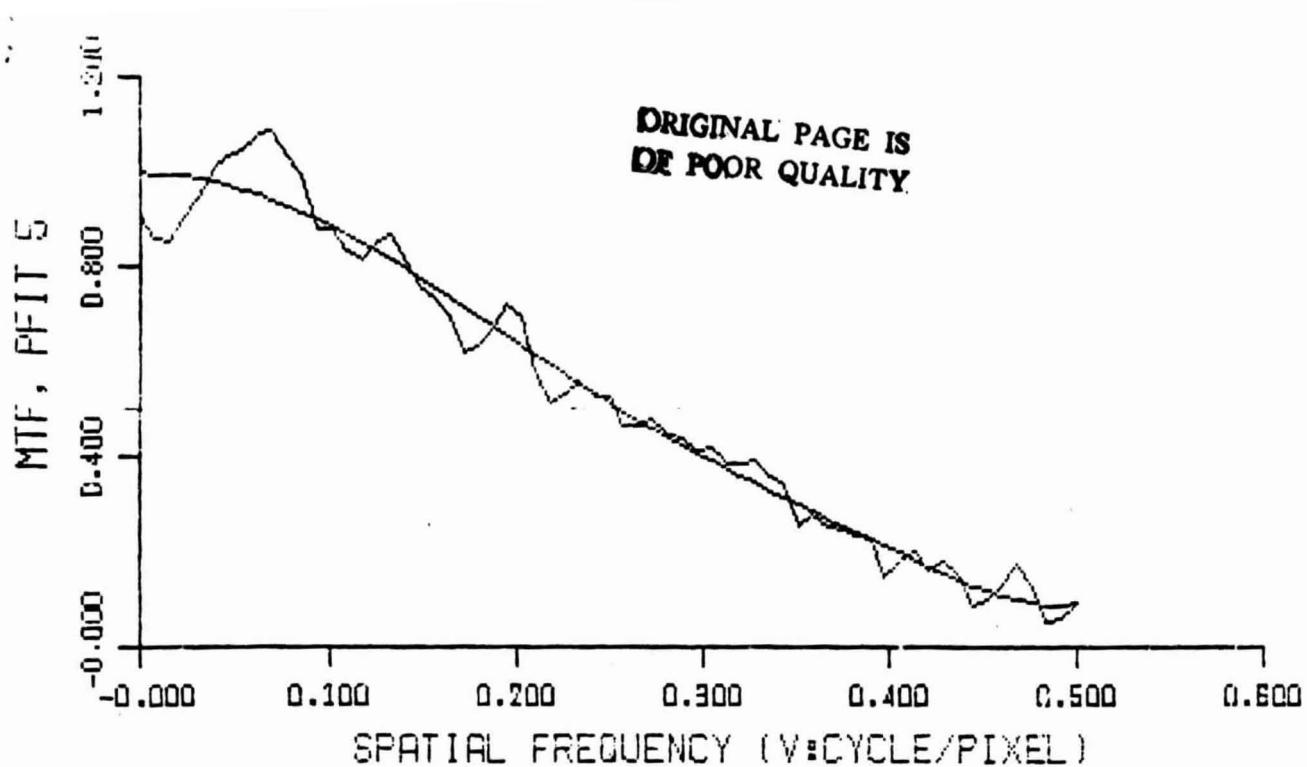
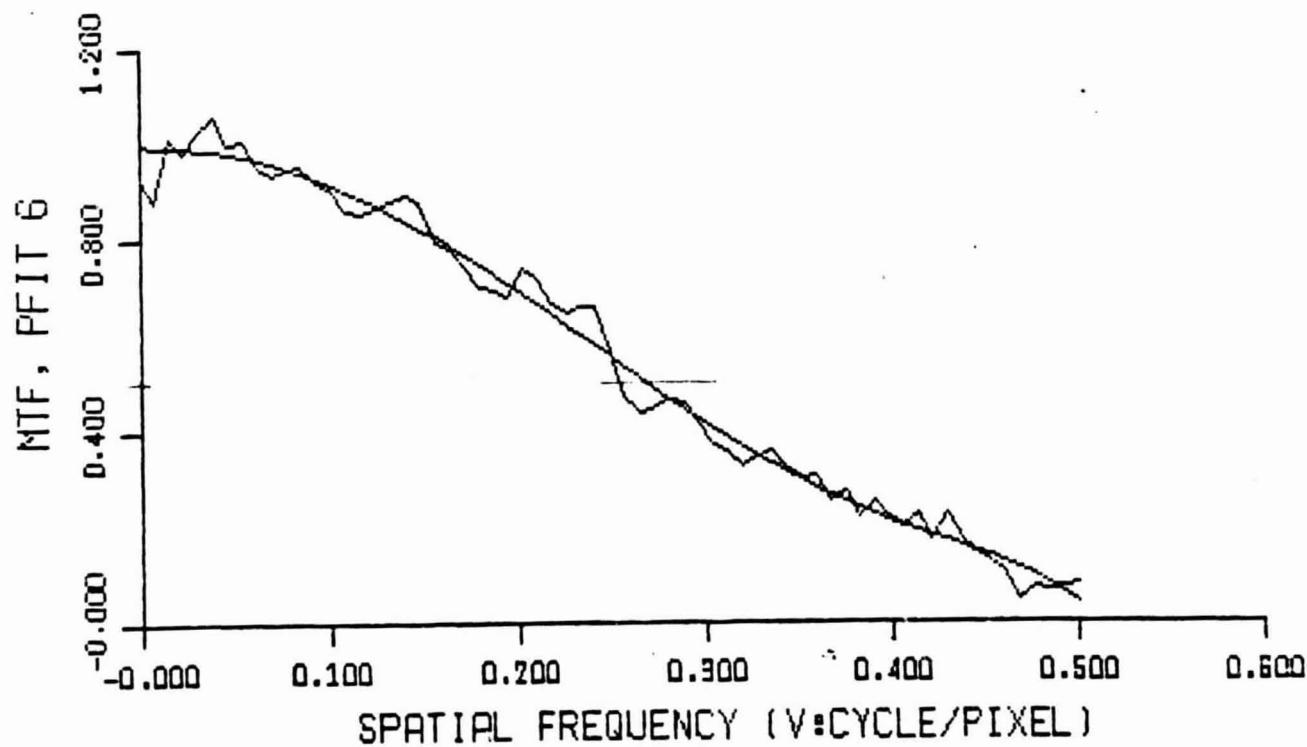


Figure 2. TM system MTFs from two-image analysis - San Jose site



SJS TM1/MSS3 MD3
a. angular region # 5



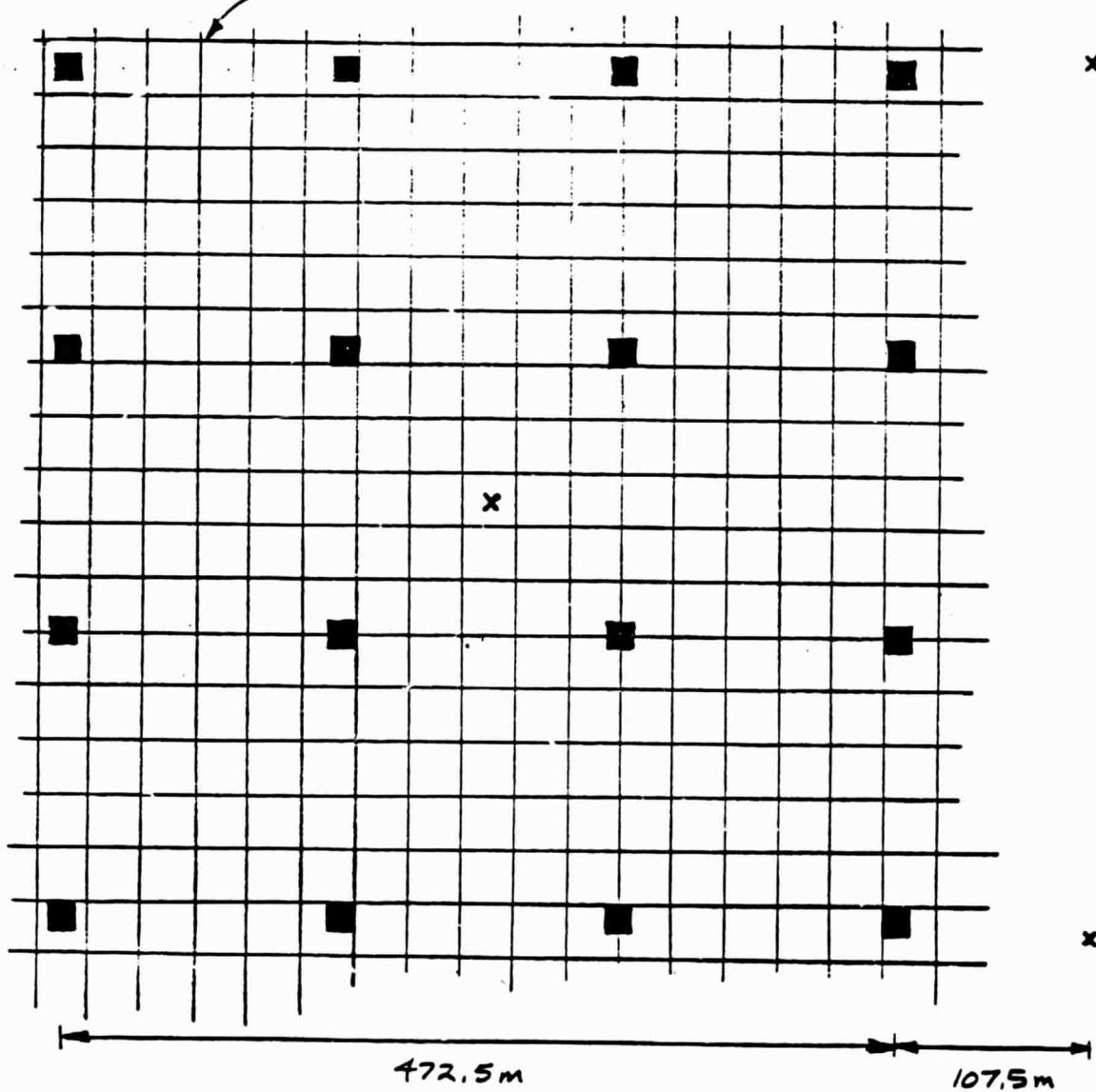
SJS TM1/MSS3 MD3
b. angular region # 6

Figure 3. TM system MTFs from two-image analysis - San Jose site

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TM WHITE SANDS MTF TARGET 10/84

EACH BLACK SQUARE IS 15 X 15 M
CENTER-TO-CENTER DISTANCE IS 157.5 m
EXAMPLE 30 X 30 m PIXEL GRID



BLACK CROSSES ARE APPROX. 4 X 4 m - USED FOR
GEOMETRIC CONTROL POINTS IN AERIAL IMAGERY

Figure 4. Final target design for Landsat-5 MTF analysis

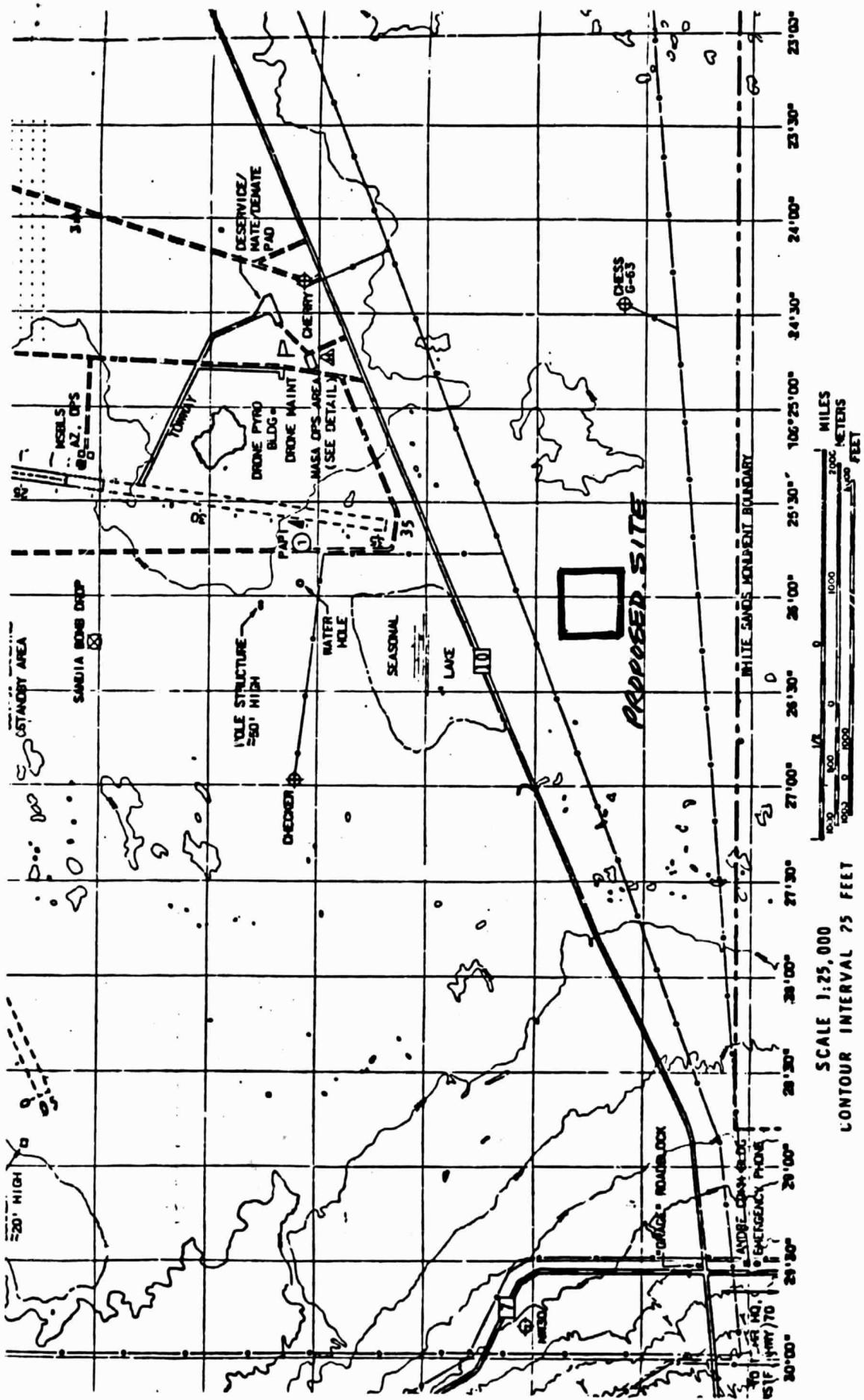


Figure 5. Final target site for Landsat-5 TM analysis

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